HR-214 Feasibility Study of Strengthening Existing Single Span Steel Beam Concrete Deck Bridges

Key Words: Post-tensioning, Concrete deck bridges, Bridge strengthening

ABSTRACT

Iowa has the same problem that confronts most states in the United States: many bridges constructed more than 20 years ago either have deteriorated to the point that they are inadequate for original design loads or have been rendered inadequate by changes in design/maintenance standards or design loads. Inadequate bridges require either strengthening or posting for reduced loads.

A sizeable number of single span, composite concrete deck-steel I beam bridges in Iowa currently cannot be rated to carry today's design loads. Various methods for strengthening the unsafe bridges have been proposed and some methods have been tried. No method appears to be as economical and promising as strengthening by post-tensioning of the steel beams.

At the time this research study was begun, the feasibility of post-tensioning existing composite bridges was unknown. As one would expect, the design of a bridge-strengthening scheme utilizing post-tensioning is quite complex. The design involves composite construction stressed in an abnormal manner (possible tension in the deck slab), consideration of different sizes of exterior and interior beams, cover-plated beams al-ready designed for maximum moment at mid-span and at plate cut-off points, complex live load distribution, and distribution of post-tensioning forces and moments among the bridge beams. Although information is available on many of these topics, there is minimal information on sev-eral of them and no information available on the total design problem.

This study, therefore, is an effort to gather some of the missing information, primarily through testing a half-size bridge model and thus determining the feasibility of strengthening composite bridges by post-tensioning. Based on the results of this study, the authors anticipate that a second phase of the study will be undertaken and directed toward strengthening of one or more prototype bridges in Iowa.

Highway bridges in the United States are designed and rated accord-ing to specifications adopted by the American Association of State High-way and Transportation Officials (AASHTO). These specifications are based on rational structural analysis, experimental investigation and engineering judgment. On a regular schedule, the AASHTO standards are revised to incorporate new information as it becomes available.

As a result of changes in the AASHTO design and rating specifica-tions and changes in Iowa design loads and deterioration, many Iowa bridges either must be posted at reduced load limits or must be strengthened. A large number of the Iowa state and county bridges that require posting or strengthening fall into the category of single-span, composite steel I-beam/concrete deck bridges constructed between 1940 and 1960. These bridges generally are of short to medium span, 30 to 80 feet, with four to six beams and one to four diaphragms. The overall objective of this research study is to explore the feasibility of strengthening this type of bridge.